



TECHNICAL REPORT

TR-130

xDSL EMS to NMS Interface Functional Requirements

Issue: 1.0
Issue Date: February 2007

Notice

The Broadband Forum is a non-profit corporation organized to create guidelines for broadband network system development and deployment. This Broadband Forum Technical Report has been approved by members of the Forum. This Broadband Forum Technical Report is not binding on the Broadband Forum, any of its members, or any developer or service provider. This Broadband Forum Technical Report is subject to change, but only with approval of members of the Forum. This Technical Report is copyrighted by the Broadband Forum, and all rights are reserved. Portions of this Technical Report may be copyrighted by Broadband Forum members.

This Broadband Forum Technical Report is provided AS IS, WITH ALL FAULTS. ANY PERSON HOLDING A COPYRIGHT IN THIS BROADBAND FORUM TECHNICAL REPORT, OR ANY PORTION THEREOF, DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY:

- (A) OF ACCURACY, COMPLETENESS, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, OR TITLE;
- (B) THAT THE CONTENTS OF THIS BROADBAND FORUM TECHNICAL REPORT ARE SUITABLE FOR ANY PURPOSE, EVEN IF THAT PURPOSE IS KNOWN TO THE COPYRIGHT HOLDER;
- (C) THAT THE IMPLEMENTATION OF THE CONTENTS OF THE DOCUMENTATION WILL NOT INFRINGE ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADEMARKS OR OTHER RIGHTS.

By using this Broadband Forum Technical Report, users acknowledge that implementation may require licenses to patents. The Broadband Forum encourages but does not require its members to identify such patents. For a list of declarations made by Broadband Forum member companies, please see <http://www.broadband-forum.org>. No assurance is given that licenses to patents necessary to implement this Technical Report will be available for license at all or on reasonable and non-discriminatory terms.

ANY PERSON HOLDING A COPYRIGHT IN THIS BROADBAND FORUM TECHNICAL REPORT, OR ANY PORTION THEREOF, DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW (A) ANY LIABILITY (INCLUDING DIRECT, INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES UNDER ANY LEGAL THEORY) ARISING FROM OR RELATED TO THE USE OF OR RELIANCE UPON THIS TECHNICAL REPORT; AND (B) ANY OBLIGATION TO UPDATE OR CORRECT THIS TECHNICAL REPORT.

Broadband Forum Technical Reports may be copied, downloaded, stored on a server or otherwise re-distributed in their entirety only, and may not be modified without the advance written permission of the Broadband Forum.

The text of this notice must be included in all copies.

Version History

Version Number	Version Date	Version Editor	Changes
Issue 1	December 2006	Anna Salguero - AT&T Labs	Original
Issue 1	February 2007	The Broadband Forum Administrative	Minor Editorial - Removed Track Changes, added TR Version Table

Technical comments or questions about this document SHOULD be directed to:

Editor: Anna Salguero AT&T Labs Salguero@labs.att.com

Operations & Network Management™ Working Group Chair Peter Adams BT p.f.adams@btopenworld.com

TABLE OF CONTENTS

1.	PURPOSE	8
2.	SCOPE.....	8
2.1	DEFINITIONS.....	9
2.2	CONVENTIONS	11
3.	REFERENCES.....	11
4.	NETWORK MANAGEMENT ARCHITECTURE.....	13
5.	FUNCTIONAL PERSPECTIVE.....	14
5.1	ASSUMED FUNCTIONS OF THE xDSL EMS	15
5.2	ASSUMED FUNCTIONS OF THE NMS.....	16
5.3	IMPLEMENTATION GUIDELINES.....	17
5.3.1	NMS to EMS Interface	17
5.3.2	EMS Translation to Vendor-Specific Parameters.....	17
6.	INTERFACE FUNCTIONAL REQUIREMENTS.....	17
6.1	GENERAL REQUIREMENTS	17
6.1.1	EMS Responses to NMS Messages and Their Correlation	17
6.1.2	Sequence Number for Autonomous EMS messages to NMS	17
6.1.3	Logging of Autonomous EMS messages	17
6.1.4	Logical NE Definition.....	18
6.1.5	Association of Connection ID to NE Autonomous Messages.....	18
6.1.6	Support of NMS/EMS Link Heartbeat.....	19
6.1.7	EMS Acknowledgment	19
6.1.8	EMS Information.....	19
6.1.9	Event Handling	19
6.1.10	Software Upgrades	20
6.2	CONFIGURATION MANAGEMENT	20
6.2.1	Retrieval of the NE List and Supported Connection IDs.....	20
6.2.2	Manipulation and Application of EMS Profiles.....	20
6.2.3	Transport Level Cross-Connection (Logical Provisioning).....	20
6.2.4	Allow/Inhibit Switching of Transport Flow.....	21
6.2.5	Request EMS to Retrieve NE Inventory Data.....	21
6.2.6	Request EMS to Provide an Available Port Assignment.....	22
6.2.7	"On-Demand" Discovery of Network Topology.....	22
6.2.8	Auto-discovery	22
6.2.9	Edit User Definable Labels.....	23
6.2.10	Capability to Provision DSL Lines	23
6.2.11	Capability to Pre-Provision DSL Lines	23
6.2.12	Capability to Provision DSL Channels.....	23
6.2.13	Request DSL Port Status.....	23
6.2.14	Provision Signaling Channel.....	23
6.2.15	Enable/Disable SVC on NE	23
6.3	FAULT MANAGEMENT	24
6.3.1	Reporting of NE Alarms/Events Across the EMS-NMS Interface	24
6.3.2	Autonomous Reporting of EMS-Generated Events/Alerts.....	24
6.3.3	Upload Autonomous Messages Upon Link Re-activation.....	25
6.3.4	Manipulation of the EMS Alarm/Event Filter from NMS.....	25
6.3.5	Allow/Inhibit EMS Uplink Autonomous Messages to NMS.....	25
6.3.6	Allow/Inhibit Specific NE Autonomous Messages	25

6.3.7	<i>Retrieval of Current NE Status Information</i>	26
6.3.8	<i>xDSL Line Status Data</i>	26
6.3.9	<i>VDSL2 Per Band Status Data</i>	26
6.3.10	<i>xDSL Channel Status Data</i>	26
6.3.11	<i>xDSL xTU Sub-Carrier Status</i>	26
6.3.12	<i>OAM Cell Loopback (F4/F5)</i>	26
6.3.13	<i>Ethernet Service OAM Connectivity Check</i>	26
6.3.14	<i>Additional Miscellaneous Loopbacks</i>	26
6.3.15	<i>Alarm Threshold Setting</i>	26
6.3.16	<i>Alarm Severity Assignment</i>	27
6.3.17	<i>Alarm Storage Duration</i>	27
6.3.18	<i>Required Alarm Attributes</i>	27
6.3.19	<i>Correlation of Alarms</i>	27
6.3.20	<i>Testing and Diagnostics</i>	27
6.3.21	<i>Loop Testing</i>	27
6.4	PERFORMANCE MANAGEMENT	27
6.4.1	<i>xDSL Line Performance Data</i>	28
6.4.2	<i>xDSL Channel Performance Data</i>	28
6.4.3	<i>Retrieval of Performance Monitoring Register Data</i>	28
6.4.4	<i>Suspect Performance Data Indicator</i>	28
6.4.5	<i>Autonomous Performance Data Reporting</i>	28
6.4.6	<i>Bulk PM Data upload</i>	28
6.4.7	<i>Performance History Storage</i>	28
6.4.8	<i>Threshold Crossing Alerts</i>	28
6.4.9	<i>Impairment and Congestion Indications</i>	29
6.4.10	<i>Usage Information</i>	29
6.4.11	<i>Capacity information</i>	29
6.5	SECURITY MANAGEMENT	29
6.5.1	<i>Set Privileges, Authentication Data and Passwords for Access to NE(s)</i>	29
6.5.2	<i>Set Privileges, Authentication Data and Passwords for Access to EMS</i>	29
6.5.3	<i>Autonomous Reporting of NE Security Messages</i>	30
6.5.4	<i>NMS/EMS Interface Link Security</i>	30
6.5.5	<i>NMS/EMS Interface Access Control</i>	30
6.6	ACCOUNTING MANAGEMENT	30

FIGURE 1/WT-130 - EXAMPLE OF BROADBAND NMS ENVIRONMENT 14
FIGURE 2/WT-130 - EXAMPLE OF A DSL NETWORK MANAGEMENT ARCHITECTURE..... 15

Summary

This Technical Report provides high level functional requirements describing an interface from a DSL Element Management System (EMS) to a Network Layer Inter-domain Network Management System (NMS). TR-130 represents a revision of TR-30 to incorporate TR-65 and cover the management of all types of DSL technologies, including ATM, Ethernet, STM and Packet transport based ADSL and VDSL access networks.

The Broadband Forum Technical Report TR-130

xDSL EMS to NMS Protocol-Independent Interface Functional Requirements

1. Purpose

The purpose of this Technical Report is to provide high level functional requirements describing an interface from a DSL Element Management System (EMS) to a Network Layer Inter-domain Network Management System (NMS). This technical report is a merger of an earlier version of TR-30 and TR-65. It is intended to cover the management of all types of DSL technologies, including ATM, Ethernet, Synchronous Transfer Mode (STM) and Packet Transport Mode (PTM) based ADSL and VDSL access networks. This technical report defines an interface that is based on the ATM Forum's M4 Network View-logical MIB and ITU-T M. 3100 network management standards. These functional requirements will provide input to subsequent EMS/NMS interface information modeling work as well as provide a basis for future protocol-dependent interface requirements.

The xDSL EMS to NMS Interface needs to provide management support for new flavors of DSL technology standardized by ITU-T:

- ADSL2 (G.992.3)
- ADSL2lite (G.992.4)
- ADSL2plus (G.992.5)
- VDSL (G.993.1)
- VDSL2 (G.993.2)

This document addresses interworking requirements. It is not the intent of this document to provide Ethernet-service or ATM-specific requirements. Thus, topics like link aggregation and traffic shaping/conditioning are not covered here. However, these and other service-specific requirements are a work in progress in a document entitled, "Protocol Independent Management Model for TR-101 Compliant Access Nodes."

2. Scope

This technical report addresses the following areas for the EMS/NMS interface in the DSL environment:

- a) Network management architecture (Section 4).
- b) Functional perspective of the EMS and NMS (Section 5).
- c) Functional requirements (Section 6) including
 - (i.) General requirements and assumptions,
 - (ii.) Configuration management;
 - (iii.) Fault management;

- (iv.) Performance management;
- (v.) Security management; and
- (vi.) Accounting management.

2.1 Definitions

The following terms are defined in this section.

Asynchronous Transfer Mode (ATM): a connection-oriented high-speed communications protocol in which data is divided into 48 byte “cells” that can be individually switched and routed. Each cell is pre-appended with a 5 byte “header” containing an identifier of the connection of which the data is a part, along with quality of service parameters associated with the connection.

Connection ID: Identifies logical Transport Level Connection entities such as ATM VCC(s) and VPC(s) and Ethernet EVC(s). The term *connection* is analogous to the concept of flow in Ethernet. The term *connection ID* includes the representation of the identifiers of Ethernet Flows.

Customer: an entity to which the service provider provides network services.

Dual End Loop Test (DELT): A dual-ended test after a DSL modem has been deployed on the customer premise to help troubleshoot a line or to capture a baseline of loop characteristics at the time of installation. As a consequence of having a transmitter and receiver located in the modems on each end of the line, the capability exists to probe or test the line over a wide range of frequencies.

Element Management System (EMS): typically provided by a network element supplier and capable of managing multiple network elements of that supplier. An EMS can communicate with one or more NE(s) on an individual or collective basis (e.g., individually to a switch or collectively to a SONET ring). An EMS can have some network management layer capabilities, particularly, when an EMS manages multiple types of NE(s) and/or NE(s) from multiple suppliers.

Ethernet Virtual Connection (EVC): An association of two or more UNIs that limits the exchange of frames to UNIs in the Ethernet Virtual Connection

Management Information Base (MIB): a set of data elements and capabilities made available by a system to enable it to be managed. The CMIP protocol relies upon a formal definition of a system’s MIB written in a language called “GDMO.”

NE: a Network Element

Network: one or more subnetworks connected by network links, providing end-to-end service to one or more customers. Each subnetwork is administered by an EMS and the network is administered by a service provider.

Network Management System (NMS): responsible for end-to-end management of a network composed of network elements from multiple suppliers. Instead of directly managing network elements, it relies upon the capabilities of the EMS(s). An NMS can interface with one or more Service Management Systems and can include some service management functionality. An NMS can also include some element management layer capabilities that allow it to manage individual NE(s) or it can contain only network management layer functionality to manage one or more EMS(s).

Port: an access point on an NE to which a link or a customer access link is attached.

Permanent Virtual Connection (PVC): an ATM connection established to provide a “permanent” communications channel similar to the way private lines are used in narrowband communications.

Packet Transfer Mode (PTM): A connectionless, high-speed data communications protocol where data is broken into variable-size packets (an entire message or a segment of a larger message), and those packets are relayed from one node to another, often in multiple parallel paths, until they reach their final destination.

Synchronous Transfer Mode (STM): Synchronous circuit switching transfer mode that transfers multiplexed standard constant bit rate channels.

Quality of Service (QoS): parameters describing the attributes of a connection such as bandwidth, burstiness of the information on the connection, and priority.

Subnetwork: a collection of one or more NE(s), interconnected by subnetwork links, with connectivity between any pair of NE(s) (i.e., the topology is a connected graph).

Virtual Channel Connection (VCC): an ATM connection identified on each end of the network by the combination of a virtual channel identifier (VCI) and a virtual path identifier (VPI) unique to that interface, and having an associated quality of service (QoS).

Virtual Channel Identifier (VCI): an integer in each ATM cell header identifying the virtual channel of which the information in the cell is a part.

VLAN ID (Virtual LAN Identifier): the identity of the VLAN on an Ethernet port.

Virtual Path Connection (VPC): an ATM connection identified on each end of the network by a virtual path identifier (VPI) unique to that interface, and capable of “containing” a number of virtual channel connections to be transmitted through the network as a single stream of information.

Virtual Path Identifier (VPI): an integer in each ATM cell header identifying the virtual path of which the information in the cell is a part.

2.2 Conventions

In this document, several words are used to signify the requirements of the specification. These words are often capitalized.

- MUST** This word, or the adjective “REQUIRED”, means that the definition is an absolute requirement of the specification.
- MUST NOT** This phrase means that the definition is an absolute prohibition of the specification.
- SHOULD** This word, or the adjective “RECOMMENDED”, means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications must be understood and carefully weighted before choosing a different course.
- MAY** This word, or the adjective “OPTIONAL”, means that this item is one of an allowed set of alternatives. An implementation that does not include this option **MUST** be prepared to inter-operate with another implementation that does include the option.

3. References

The following Broadband Forum Technical Reports and other references contain provisions, which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All Technical Reports and other references are subject to revision; users of this Technical Report are therefore encouraged to investigate the possibility of applying the most recent edition of the Technical Report and other references listed below. A list of the currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

NOTE – The reference to a document within this Technical Report does not give it, as a stand-alone document, the status of a Technical Report.

- [1] Telcordia GR-2869-CORE (Issue 3, April 2001), *Generic Requirements for Operations Based on the Telecommunications Management Network (TMN) Architecture*.
- [2] ATM Forum AF-NM-0058.001 Version 2.0 (May 1999), *M4 Interface Requirements and Logical MIB. ATM Network View*.
- [3] ATM Forum AF-NM-0020.001 (Version 2.0, October 1998), *M4 Interface Requirements and Logical MIB. ATM Network Element View*,
- [4] ITU-T Recommendation M.3010 (February 2000), Principles f o r a Telecommunications Management Network.

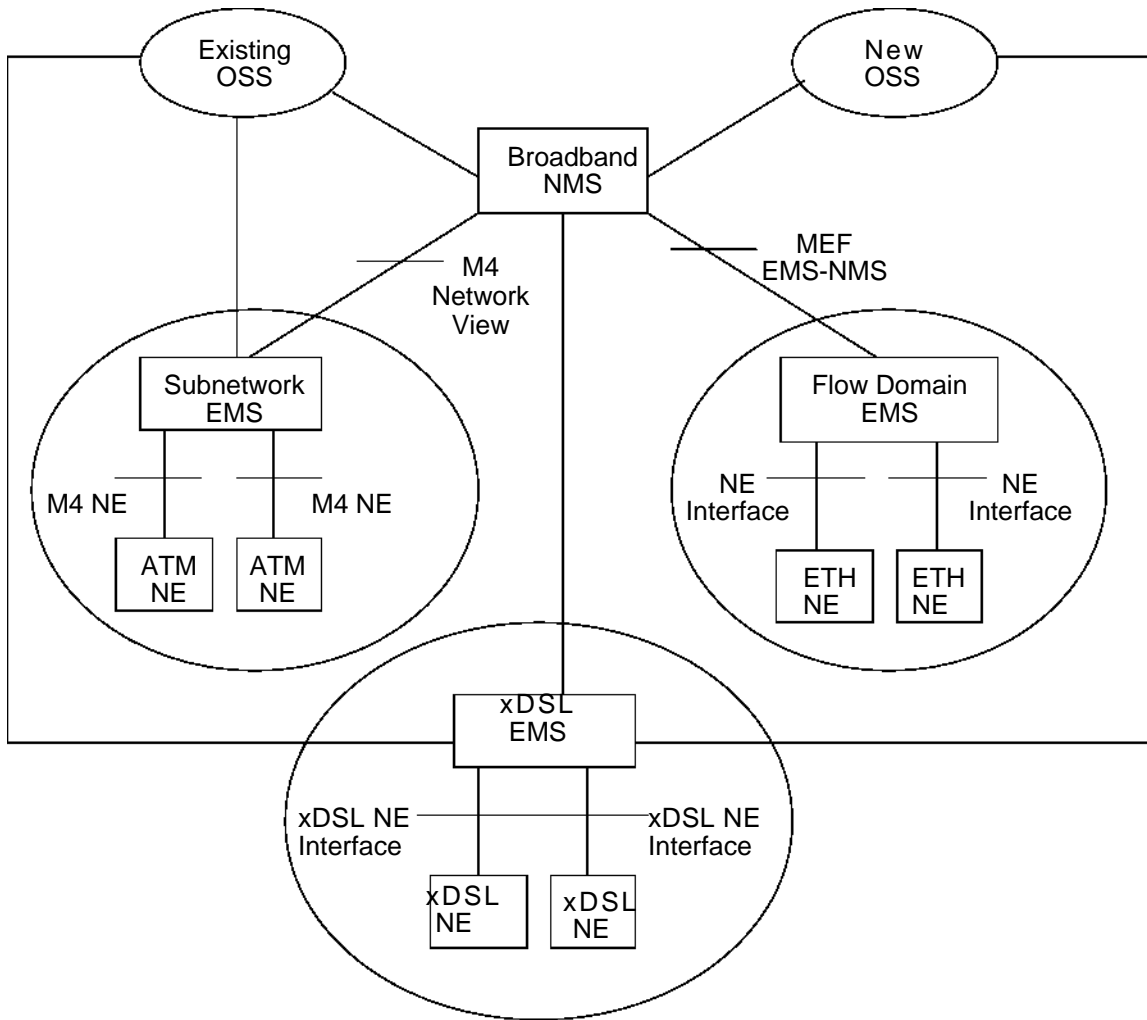
- [5] ITU-T Recommendation M.3100 (April 2005), *Generic Network Information Model*.
- [6] SR-2690, *Requirements for an EML Platform Environment*, Telcordia, Issue 2, December 2000.
- [7] Telcordia GR-2004 (February 1999), *Generic Requirements for the Operations Interface Between Hybrid SONET/ATM Element Management Systems and Network Management Systems*.
- [8] ITU-T Recommendation X.721 (January 1992), *Information Technology – Open Systems Interconnection – Structure of Management Information: Definition of Management Information*.
- [9] ITU-T Recommendation X.720 (January 1992), *Information Technology – Open Systems Interconnection – Structure of Management Information: Management Information Model*.
- [10] Broadband Forum TR-057 (February 2003), *VDSL Network Element Management*.
- [11] ITU-T Recommendation H.61 1 (July 2003), *Operations, administration & provisioning aspects of a full-service VDSL platform*.
- [12] ITU-T Recommendation I.610 (February 1999), “B-ISDN operation and maintenance principles and functions”.
- [13] Broadband Forum TR-090 (December 2004), *Protocol Independent Object Model for Managing Next Generation ADSL Technologies*.
- [14] Broadband Forum TR-066 (March 2004), *ADSL Network Element Management*.
- [15] ITU-T Recommendation G. 992.1 (July 1999), *Asymmetric Digital Subscriber Line (ADSL) transceivers*.
- [16] ITU-T Recommendation G. 992.2 (July 1999), *Splitterless Asymmetric Digital Subscriber Line (ADSL) transceivers*.
- [17] ITU-T Recommendation G.992.3 (January 2005), *Asymmetric Digital Subscriber Line (ADSL) transceivers -2 (ADSL2)*.
- [18] ITU-T Recommendation G.992.4 (July 2002), *Splitterless Asymmetric Digital Subscriber Line (ADSL) transceivers - 2 (ADSL2)*.
- [19] ITU-T Recommendation G.992.5 (January 2005), *Asymmetric Digital Subscriber Line (ADSL) transceivers– Extended Bandwidth ADSL2 (ADSL2plus)*.

- [20] ITU-T Recommendation G.993.1 (June 2004), *Very high speed digital subscriber line transceivers*.
- [21] ITU-T Recommendation G.993.2 (February 2006), *Very high speed digital subscriber line transceivers 2 (VDSL2)*.
- [22] ITU-T Recommendation G.997.1 (June 2006), *Physical layer management for digital subscriber line (DSL) transceivers*.
- [23] Broadband Forum TR-128 (September 2006), *Addendum to TR-090*.
- [24] Broadband Forum TR-129 (December 2006) Version 4.0, *Protocol Independent Object Model for Managing VDSL2*.
- [25] ITU-T Recommendation X.680 (July 2002), *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.
- [26] ITU-T Recommendation X.731 (1992), *Information Technology – Open Systems Interconnection – Systems Management – State management function*.
- [27] ITU-T Recommendation X.733 (1992), *Information Technology – Open Systems Interconnection – Systems Management – Alarm Reporting Function*.
- [28] ITU-T Recommendation X.736 (1992), *Information Technology – Open Systems Interconnection – Systems Management – Security Alarm Reporting Function*.

4. Network Management Architecture

This section describes a typical Broadband Network Management Architecture for managing an ATM, Ethernet, STM and Packet transport based DSL access network which provides the basis for this technical report. In a Broadband OSS architecture, an NMS provides end-to-end network management functions for a multiple-supplier, multiple-technology network. This architecture leverages the capabilities of network-supplier EMS products and also supports gateway interfaces to upstream Operation Support Systems (OSS).

Figure 1/WT-130 depicts the typical environment in which the DSL EMS and Broadband NMS could co-exist. The Broadband NMS interfaces to subnetwork management systems that manage the network. The network managed by the NMS could include ATM, SONET, SDH, WDM, Ethernet, DSL and other broadband type network elements.



- Legend:**
- MEF EMS-NMS** – The EMS – NMS interface defined by the MetroEthernet Forum in MEF-7.
 - M4 Network View** – The EMS–NMS interface defined within the ATM Forum in AF-NM0058.001.
 - Flow Domain EMS** – An EMS that is responsible for managing a connectionless Flow Domain.
 - Subnetwork EMS** – An EMS that is responsible for managing a connection oriented Subnetwork.
 - M4 NE** – The NE to EMS interface as defined in AF-NM-0071.000.

Figure 1/WT-130 - Example of Broadband NMS environment

5. Functional Perspective

For informational purposes only, this section addresses the functional perspective assumed functions of the DSL EMS and Broadband NMS, and EMS to NMS interface implementation guidelines. NE(s) typically interface to an DSL EMS as shown in Figure 2/WT-130. This EMS can be considered a supplier-specific EMS. The supplier typically provides documentation on the capabilities of that EMS. The EMS MAY have either an

open interface or a proprietary interface to allow it to manage a subnetwork of NE(s). If a standards-based versus proprietary interface is used standard MIB(s) are preferred.¹

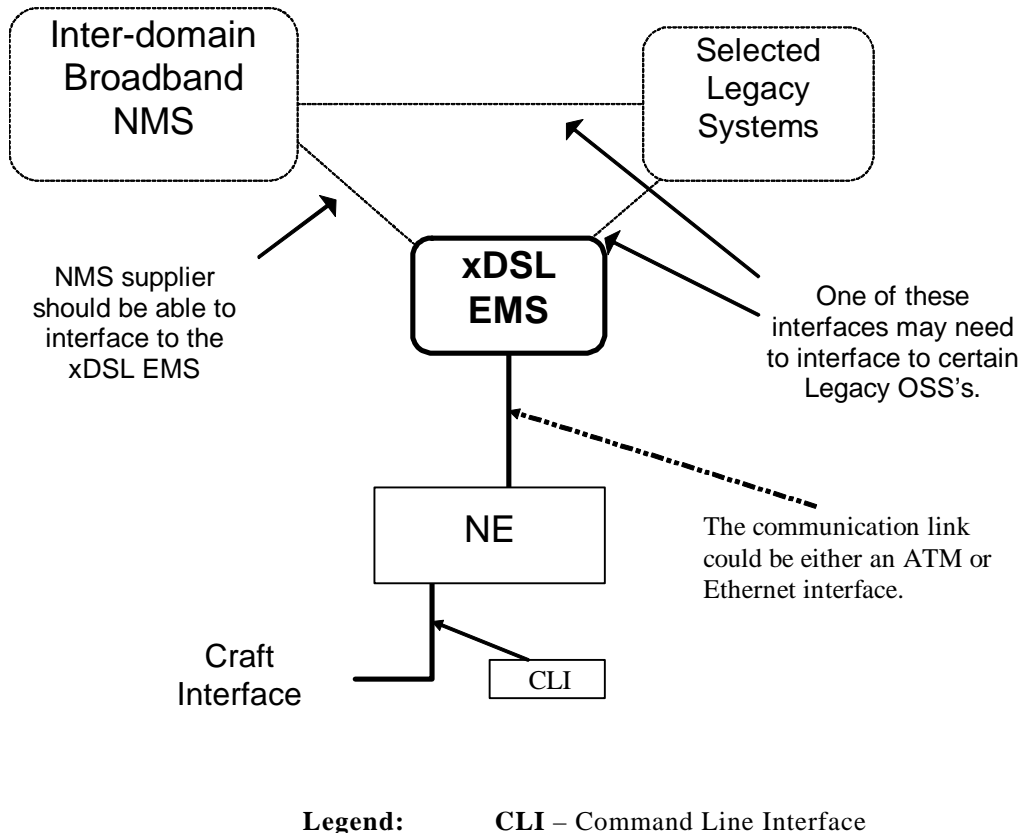


Figure 2/WT-130 - Example of a DSL network management architecture

5.1 Assumed Functions of the xDSL EMS

An xDSL EMS provides element-level management of the xDSL access subnetwork made up of DSLAM(s), xTU-C(s) and xTU-R(s). While an instance of a xDSL EMS may be dedicated to the management of a single xDSL technology (e.g., ADSL), an xDSL EMS can manage both ADSL and VDSL facilities.

xDSL EMS capabilities can include:

- Inventory and Utilization Management for aiding network planning;
- Configuration Management for creation/deletion of the DSL line parameters;
- Connection Management for setting up/tearing down Transport Level Connections (e.g., ATM VCC(s), Ethernet EVCs) between the user and the network;
- Access Management for broadcast video channels;
- Fault Management for assessing the impact of xDSL line failures;

¹ An "open" interface is one which has been published in sufficient detail for other manufacturers to build equipment that can inter-operate. A "standard open" interface is not only published, but has been agreed to in a standards body, such as the IETF.

- Performance Management for reporting and control of DSL performance characteristics;
- Security Management for partitioning the element layer view and control;
- Accounting management to extract parameters used in billing;
- Software and data management; and
- Establishing and monitoring the communication between the EMS and NE(s).

5.2 Assumed Functions of the NMS

The Broadband NMS provides end-to-end network-level management of Broadband networks composed of ATM, Ethernet, DSL and other broadband subnetworks. NMS capabilities can include:

- Planning management for controlling network build;
- Configuration Management for creation/deletion of network links that connect subnetwork, which can include Dynamic Line and Spectrum Management;
- Connection Management for setting up/tearing down end-to-end Transport Level Connections (e.g., ATM VCC(s), Ethernet EVC(s), etc.) using inter-subnetwork routing;
- Access Management for video broadcast channels;
- Adaptation/Interworking Management for defining adaptation and interworking points between Layer Networks;
- Alarm/event management to identify and isolate troubles;
- Fault Management for assessing the impact of network link failures on existing VCC(s);
- Performance management of xDSL lines;
- Security Management for partitioning the network view and control;
- Accounting Management for billing purposes;
- Communication with EMS systems for managing individual subnetworks; and
- Software and data management of xDSL NEs.

The Broadband NMS **SHOULD** provide gateway interfaces to existing OSSs and new OSSs to support service activation, service assurance, network planning, network engineering and billing.

The Broadband NMS **SHOULD** provide a cut-through capability from the NMS GUI to a specific EMS as if the NMS user is using the EMS GUI.

The NMS **MUST** be responsible for data synchronization between the NMS and the EMS(s) by on-demand auditing of the EMS database(s). The NMS **MUST** also be able to audit a specific part of the EMS database(s). The steward for interface objects is the EMS, but the NMS is responsible for synchronization.

5.3 Implementation Guidelines

5.3.1 NMS to EMS Interface

The NMS commands are targeted for the EMS(s). How the command is processed by the EMS is an internal EMS design choice. For example, an EMS MAY respond to the NMS command by looking at its database, or it MAY send a request to its subtending NE(s) to obtain the requested information and then respond back to the NMS. Furthermore, to respond to a NMS request, an EMS MAY need to issue multiple commands in its domain to perform the requested NMS operations. It is up to the EMS to perform such tasks.

5.3.2 EMS Translation to Vendor-Specific Parameters

The intent is to provide a unified EMS/NMS interface across all the EMS(s). The EMS(s) SHOULD be responsible for translating all standard information (e.g. Managed Object representation) to vendor-specific representation.

6. Interface Functional Requirements

This section addresses the EMS to NMS functional requirements categorized by the systems management functional areas defined by the ITU in Recommendation M.3010: Configuration Management, Fault Management, Performance Management, Accounting Management and Security Management.

6.1 General Requirements

6.1.1 EMS Responses to NMS Messages and Their Correlation

The EMS response to NMS messages MUST contain a correlation indicator to the NMS input command. In the response to an NMS message, the EMS could echo back the same correlation indicator contained in the NMS message. The NMS is responsible for the uniqueness of the correlation indicator across all its subtending EMS(s).

6.1.2 Sequence Number for Autonomous EMS messages to NMS

For each EMS autonomous message to the NMS, the EMS MUST assign a sequence number for that message. Such a sequence number SHOULD be included in all EMS autonomous messages. Note that these autonomous messages MAY be EMS-generated or NE-generated alarms, events or report database changes. These sequence numbers are used by the NMS to identify the missing autonomous EMS messages. Sequence numbers need to be unique and expressed in INTEGER format. The EMS MUST maintain sequence numbers per NMS client instance.

6.1.3 Logging of Autonomous EMS messages

The EMS SHOULD provide a logging function for all autonomous messages generated by the EMS or the NE. Specific logging requirements SHOULD be defined by the protocol-dependent interface requirements.

6.1.4 Logical NE Definition

A Logical NE (LNE) is a collection of NE(s) which can be viewed from an NMS perspective as a single provisionable and/or maintainable entity. To implement an NMS logical NE command, an EMS MAY need to issue multiple commands to perform the requested logical NE operations in its domain. For example, if an ATM EMS is used, from the NMS perspective, the ATM cloud would be a logical NE. For provisioning, the NMS needs only to define the entrance and exit points to the ATM cloud. The ATM EMS takes care of all appropriate cross-connects and routing in its domain. The EMS provides a grouping of NE(s) which behave as a logical NE to the NMS. Logical NE(s) belong to one EMS domain and can not cross EMS domains. A Containment hierarchy can be used to model logical NE clustering in the NMS MIB.

A logical NE subnetwork is required for ATM connection management to set up, release, and modify point-to-point and multi-point ATM subnetwork connections. Network View objects will be used even though the EMS will send objects per NE. It is RECOMMENDED that atomic subnetworks be supported.

6.1.5 Association of Connection ID to NE Autonomous Messages

The circuit ID is an important concept in a Service Provider's environments. Traditionally, this circuit ID is applied to network physical entities. It is proposed that this concept be extended to the logical Transport Level Connection entities such as ATM VCC(s) and VPC(s) and Ethernet EVC(s) by using the term connection ID. Note: The term *connection* is analogous to the concept of flow in Ethernet. The term *connection ID* is used in this text and includes the representation of the identifiers of Ethernet Flows.

The general philosophy is as follows: the NMS requests the creation of a particular flow across the subnetwork managed by the EMS; the EMS checks that such a flow is possible and then assigns a connection ID. The EMS then stores the connection ID and appends it to the associated NE autonomous messages, whenever they are forwarded from the EMS to the NMS. This would require an EMS to be able to relate the connection ID to:

- Ethernet Virtual Connection(s) (end-to-end logical Ethernet flows)
- ATM VCC(s) (an end-to-end connection consisting of multiple VPL[s])
- Cross EMS Virtual Paths (VP(s))
- Cross EMS physical transmission facilities (e.g., SONET, DS3, PON)
- DSL lines

Hence, the connection ID MUST be associated with physical facilities as well as Transport Level logical entities. The NMS stores the relationship between the connection ID and the circuit ID, EVC ID, or PVC ID that the subnetwork flow supports. Although the circuit ID, EVC ID, or PVC ID is an NMS concept, the connection ID, known to both EMS and NMS provides the identifier to simplify the cross-EMS event correlation at the NMS.

If an autonomous message is associated with a high level facility or equipment then only the connection/flow ID closely associated with that root cause **MUST** be appended to the message which is sent from the EMS to NMS. It is not required to transmit all the impacted lower level connection/flow IDs. That is, only the root cause connection/flow ID is reported by the EMS as part of the root cause alarm. The NMS will provide the appropriate mapping to lower level connection/flow IDs.

6.1.6 Support of NMS/EMS Link Heartbeat

The NMS **SHOULD** send periodic heartbeat command to the EMS to confirm that it is connected on a user-definable interval that ranges from 1 minute to 60 minutes in 1 minute steps. The EMS **MUST** respond to the heartbeat command with a simple response, according to Section 6.1.7 below.

6.1.7 EMS Acknowledgment

If the actual response to specific NMS messages cannot be sent to the NMS within 2 seconds, the EMS **MUST** send an appropriate acknowledgment to the NMS. An acknowledgment is a response to an NMS request. This acknowledgement **MAY** be implemented for specific commands for which a response could take a long time. This feature prevents the NMS operator from issuing a command multiple times due to not receiving a response in a reasonable timeframe.

Example: If the NMS requests an EMS to perform NE software restoration and completing such task could take approximately 20 minutes, then that EMS **SHOULD** send an appropriate acknowledgment to the NMS indicating that the requested operation is being performed.

6.1.8 EMS Information

Identifying information and EMS properties such as software version and hardware information **SHOULD** be available on demand to the NMS.

Status information about the EMS **SHOULD** be available on demand to the NMS, i.e. disk space, memory, CPU usage against resources allocated to the EMS, status of links between the EMS and nodes.

6.1.9 Event Handling

G.997.1 defines how failures are declared and reported. G.997.1 also defines how performance data is accumulated/measured, stored, and retrieved as well as how performance threshold violations are reported. Event handling **MUST** be performed in accordance with Section 7 of ITU-T Recommendation G.997.1, "Physical layer management for digital subscriber line (DSL) transceivers". This requirement covers both synchronous event handling (i.e., NMS requests event information from the EMS) and asynchronous event handling (i.e., EMS send event reports upon their occurrence to the NMS).

6.1.10 Software Upgrades

Software upgrades **MUST** be initiated for any part of the NEs and NE components via the NMS-EMS Interface. It **SHOULD** be possible to group network elements together in various logical ways to initiate the upgrade of multiple elements with a single command. As a minimum this **SHOULD** include all line cards on an NE.

6.2 Configuration Management

6.2.1 Retrieval of the NE List and Supported Connection IDs

The NMS **MUST** be able to request an EMS to provide the list of NE(s) under its domain. The following information **MUST** be included where applicable: software version, hardware version, serial number, MAC address, IP address, ATM address, vendor and model number. The NMS **MUST** be able to request an EMS to provide the list of the connection IDs it supports. The NMS **MUST** be able to request an EMS to provide the list of the connection IDs that an individual NE supports.

6.2.2 Manipulation and Application of EMS Profiles

The NMS operator **SHOULD** be able to retrieve, create and distribute EMS profiles through the NMS/EMS interface. This includes DSL Line Configuration Templates defined by TR-090, TR-128, and TR-129. The NMS **MUST** also have the capability to request an EMS to apply a specific profile or a QOS class (i.e., super profile).

It is assumed that at the time of installation, when the NE is activated, it will automatically come with factory default parameters (including configuration for NE equipment and ports). However, if a different profile (other than the factory default profile) is needed, the NMS operator **MUST** have the capability to request the EMS to apply the NMS-requested profile. The NMS operator **MUST** be able to perform this function across the EMS via an NMS/EMS command. Hence, the NMS **MUST** have the capability to specify and request the EMS to apply a specific EMS-stored profile.

Retrieval of profiles and their content is a requirement. Creating and deleting profiles is also useful, however, modifying profiles would not be required. The DSL profile and traffic descriptor profiles as well as any other DSL-related profiles **SHOULD** be exposed through the interface. Profiles need not necessarily exist in the NMS.

6.2.3 Transport Level Cross-Connection (Logical Provisioning)

The EMS **MUST** be able to receive a transport level (e.g., ATM, STM, and Ethernet) cross-connection request from the NMS. To activate a service, one or multiple cross-connect commands from the NMS to EMS **MAY** need to be issued. The following information **MUST** be included in a cross-connect message:

- Ingress assigned port on an NE (or logical NE) and specific Logical ID (e.g., VPI/VCI or VPI, VLAN ID, etc.)
- Egress assigned port on NE (or logical NE) and Logical ID (e.g., VPI/VCI or VPI, VLAN ID, etc.)

- Identification of Transport Level traffic descriptor profiles, as appropriate
- Logical Connection ID associated with ATM VCC(s), VPC ID, Flows, Ethernet Virtual Connections, etc. as appropriate
- Type of cross-connection (point-to-point, multi-point, broadcast, etc.)

The NMS MUST also be able to request to disconnect (i.e., tear down) the existing Transport Level cross-connections. Finally, cross-connect parameters (i.e., properties) MUST be allowed to be changed using a modify (e.g., SET or EDIT) command.

6.2.4 Allow/Inhibit Switching of Transport Flow

The EMS to NMS interface MUST support the NMS request to inhibit/allow the switching of Transport flow (e.g., ATM Cells, Ethernet Frames, etc.) for a particular Transport Level cross-connection. When the transport flow is inhibited, the EMS MUST continue to maintain the existing Transport Level cross-connect relationship.

6.2.5 Request EMS to Retrieve NE Inventory Data

The NMS MUST be able to request an EMS to retrieve NE physical and logical inventory data. The EMS MUST respond to the NMS query by either retrieving the data from its database or directly from the NE(s).

The physical inventory data includes a list of all cards (including hardware & software versions), associated ports, and their current state information (as defined in X.731), if available, such as:

- i) in-service,
- ii) available (installed but not in service), and
- iii) pending or reserved designations. (The pending or reserved state indicates that the port has been assigned by the EMS, but it has not yet been put into service.)

The logical inventory data includes a list of all Transport Level cross-connect tables in a NE with associated current states (e.g., inhibit/allow switching, QOS, Traffic Descriptors, Connection ID, etc.)

The NMS MUST be able to request the EMS to provide the current software version of a specific NE, including all cards. The NMS MUST also be able to request the software version of all the NE(s) under an EMS domain. It is up to the EMS to respond to this request based on the information in its database or to query such data from the NE(s). Standard Port ID for all equipment SHOULD be based on the following example:

```
PortId ::= SEQUENCE {
    managedElement [0] GraphicString,
    rack [1] GraphicString OPTIONAL,
    shelf [2] GraphicString OPTIONAL,
    drawer [3] GraphicString OPTIONAL,
    slot [4] GraphicString OPTIONAL,
```

```
subslot [5] GraphicString OPTIONAL,  
plugin [6] GraphicString OPTIONAL,  
port [7] GraphicString }
```

Basically it is a sequence of seven "strings" where all are OPTIONAL except the Managed Element and Port.

Note that the definition of GraphicString can be found in X.680.

6.2.6 Request EMS to Provide an Available Port Assignment

The NMS MUST have the ability to request for an available port assignment from the EMS. The EMS MUST respond back by assigning a specific port from its inventory and changing the state of that port from "available" to "reserved" so that it can not be re-assigned before service activation. If the "pending" state of a port is not changed to "working" state after a user-defined time, the EMS MUST send a warning message to the NMS. If no action is taken by the NMS, the EMS MUST change the port status back to "available". This is to avoid indefinite tying up of the network resources if the service activation has not taken place.

6.2.7 "On-Demand" Discovery of Network Topology

The NMS MUST be able to request, on demand, the EMS to provide the view of the subnetwork of the EMS for all physical hardware and software components. This SHOULD include associated facility (i.e. DSL line, DS1, DS3, OC3, etc.) link information and link terminations for the network elements (i.e. NE(s)). The NMS MUST be able to construct an updated physical network map/topology view from such information.

If the EMS automatically and autonomously performs network discovery and has updated information in its database, then it SHOULD provide such information to the NMS, upon request. The information will also indicate the status of any component of the sub-network, i.e., in-use, spare, faulty.

6.2.8 Auto-discovery

The EMS-NMS interface MUST allow for the transmission of the auto-discovered information from the EMS to the NMS. This transparent flow-through of EMS information to the NMS is considered critical to the successful operation of a Broadband Inter-domain NMS.

6.2.8.1 Auto-discovery of "Physical Network" to NMS

Whenever the EMS creates, deletes or discovers a new NE, card, port, or facility termination (e.g., DSL line, SONET or DS3), the EMS MUST send an autonomous message to the NMS informing it of the new discovery with appropriate identification. This requirement does not specify "how" an EMS creates, deletes or discovers the underlying resources. Such discovery function could have been performed:

- Manually by the EMS user;
- Via NE autonomous messages; or
- Via EMS automatic inquiry.

6.2.8.2 Auto-discovery of "Logical Network" to NMS

Whenever the EMS creates, deletes or discovers a new Transport Level (e.g., VP, VC, Ethernet, etc.) cross-connect, the EMS MUST send an autonomous messages to the NMS informing it of the new discovery along with the connection ID and the termination points of the Transport Connection (e.g., ATM CTPs, Ethernet Flow Points, etc.).

6.2.9 Edit User Definable Labels

The EMS MUST allow the NMS to edit all user definable labels, such as connection IDs, ports, and NE(s), via the EMS-NMS interface.

6.2.10 Capability to Provision DSL Lines

The EMS MUST allow the NMS via the EMS-NMS interface to provision DSL line(s) after a NE is installed and discovered by the NMS. The DSL line configuration parameters described in Table 7-14/G.997.1 and Section 2 of TR-057 MUST be supported over the EMS-NMS interface.

6.2.11 Capability to Pre-Provision DSL Lines

The EMS MUST allow the NMS via the EMS-NMS interface to pre-provision DSL line(s) prior to NE being installed or discovered by the NMS with or without the use of profiles.

6.2.12 Capability to Provision DSL Channels

The EMS MUST allow the NMS via the EMS-NMS interface to provision DSL channels after the NE is installed and discovered by the NMS. The DSL channel configuration parameters described in Table 7-16/G.997.1 and Sections 2 and 3 of TR-057 MUST be supported over the EMS-NMS interface.

6.2.13 Request DSL Port Status

The EMS MUST allow the NMS via the EMS-NMS interface to request the status or state of a DSL port. The state or status of the port MUST indicate whether the port is assigned, pending or reserved, defective or disabled.

6.2.14 Provision Signaling Channel

The EMS MUST allow the NMS via the EMS-NMS interface to provision Switched Transport service on a UNI port for each Switched Transport Customer if supported in the NE. This process configures the signaling channel attributes, and configures the address prefix to identify the Switched Transport customer.

6.2.15 Enable/Disable SVC on NE

The EMS MUST allow the NMS via the EMS-NMS interface to enable/disable the Switched Transport Service capability on a specific NE if supported by the NE. It is

assumed that all Switched Transport Service-related profiles have already been created in the target NE via the EMS GUI.

6.3 Fault Management

6.3.1 Reporting of NE Alarms/Events Across the EMS-NMS Interface

This section addresses reporting of NE-generated alarms and events from EMS to NMS. As such, ITU-T Recommendations X.733 and X.736 are relevant documents in support of these requirements. The xDSL EMS MUST provide appended information associated with NE messages before they are forwarded to the NMS. The xDSL EMS MUST forward all alarms/events (i.e., the ones passing through the filter residing in the EMS, see subsequent sections) originating from the NE(s) (e.g., NE and DSL, ATM, Ethernet, SONET and DS3 terminations).

The xDSL EMS MUST append the following information to the NE messages received at the EMS, before they are forwarded to the NMS:

- i) A unique EMS-generated sequence number for the autonomous messages.
- ii) Appending of the associated connection ID to the NE messages are required before transmitting them to NMS. These connection IDs are provided, by the NMS to the EMS(s) during the capacity and service activation processes.

Appending of a connection ID to a NE-generated message SHOULD be provided in the following cases:

- a. For those messages which are directly related to Transport Level Connection (e.g., ATM VCC(s), ATM VPC(s), Ethernet EVCs, etc.). Connection IDs are provided by the NMS to the EMS(s) during the capacity & service activation processes. The connection ID SHOULD be appended to the message.
- b. For those autonomous messages which are directly related to physical DSL, SONET or DS3 facility terminating on the NE. Connection IDs MAY be manually input into the EMS(s) during the capacity activation/resource provisioning process. The connection ID SHOULD be appended to the message.

If an autonomous message is not directly related to a connection ID (e.g., equipment alarm), then appending of all the impacted connection IDs are not required.

The xDSL EMS MUST also provide the NMS with a list of all active alarms upon request.

6.3.2 Autonomous Reporting of EMS-Generated Events/Alerts

In addition to NE-generated alarms/events, the EMS MUST generate an autonomous message to the NMS to report the following conditions:

- EMS/NE link failure

- Internal EMS processing errors

6.3.3 Upload Autonomous Messages Upon Link Re-activation

If the NMS/EMS link goes down, the EMS MUST log the autonomous messages (i.e., NE and EMS-generated alarms/events) that would have been sent to the NMS if the link was operational. Upon link re-activation, the NMS MUST automatically request the EMS to upload all stored alarm and event messages for the duration of the time that NMS/EMS link was down.

6.3.4 Manipulation of the EMS Alarm/Event Filter from NMS

The EMS MUST provide a "filter" for alarms/events which are sent from EMS to NMS. The NMS MUST be able to manipulate the EMS filter for autonomous messages so that the NMS can receive only an appropriate subset of EMS-originated or NE-originated messages. The parameters specified in this message MUST specify the criteria for filtering messages at the EMS level. The messages MUST be able to allow/inhibit EMS events from being transmitted to NMS based on parameters such as:

- Facility termination (e.g., OC3c), Transport Level Terminations (ATM VCC(s), Ethernet EVCs, etc.), equipment, subscriber, etc.
- EMS-initiated, NE-initiated, etc.
- NE ID
- Severity of alarms such as Critical, Major, Minor, etc.
- Message type (Alarms, TCA(s), PM, etc.)
- Connection ID (for both physical and logical entities)

If specific type of EMS autonomous messages are inhibited, this SHOULD not impact other commands issued by NMS and responses provided by that EMS.

The following two features MAY be implemented as a separate feature or as a specific implementations of the above filtering capability.

6.3.5 Allow/Inhibit EMS Uplink Autonomous Messages to NMS

The NMS MUST allow/inhibit "all" the EMS autonomous messages that are sent to NMS. This includes NE-generated events and EMS-generated messages. This feature MAY be used to prevent flooding of the Data Communication Network (DCN). (This is a special case of REQUIREMENT 6.3.4.)

6.3.6 Allow/Inhibit Specific NE Autonomous Messages

The NMS MUST allow/inhibit EMS transmittal of autonomous messages related to a particular NE. When the NMS inhibits autonomous messages from a NE, no messages from that NE are sent over the EMS/NMS link. The EMS SHOULD continue to receive autonomous messages from that NE. This requirement provides the capability to exclude a NE from being monitored by the NMS while it is behaving abnormally and too many alarms/alerts are generated by that NE. (This is a special case of REQUIREMENT 6.3.4.)

6.3.7 Retrieval of Current NE Status Information

The NMS MUST have the ability to retrieve current NE-specific information (i.e. current problem list, operational data) from the EMS for diagnostic purposes. This data is used to evaluate the current network situation either before or after maintenance operations. The NMS MUST restrict the status information to specific parts of the NE (i.e. ports, boards or miscellaneous equipment (e.g. fans, power supply)). The EMS MUST NOT apply any filtering to this data. If an EMS cannot provide this data from its database, it MUST query the NE to acquire the information.

6.3.8 xDSL Line Status Data

The NMS MUST have the ability to initiate a request to the xDSL EMS to obtain xDSL line status data as defined in Table 7-10/G.997.1 and Section 3.1 of TR-057.

6.3.9 VDSL2 Per Band Status Data

The NMS MUST have the ability to initiate a request to the xDSL EMS to obtain VDSL2 status data for a specific band as defined in Table 7-28/G.997.1 under the headings Attenuation (LATNds, LATNus, SATNds and SATNus parameters) and Signal-to-Noise Ratio Margin (SNRMpsds and SNRMpbus parameters).

6.3.10 xDSL Channel Status Data

The NMS MUST be able to initiate a request to the xDSL EMS to obtain xDSL channel status data, as defined in Section 3.2 of TR-057 and in Section 7.5.2 of G.997.1 and Table 7-30/G.997.1.

6.3.11 xDSL xTU Sub-Carrier Status

The NMS MUST have the ability to initiate a request to the xDSL EMS to obtain xTU Sub-Carrier Status at a particular xTU. xTU Sub-Carrier Status Data MUST include the subcarrier status data MUST include all the mandatory parameters given in Table 7-28/G.997.1.

6.3.12 OAM Cell Loopback (F4/F5)

The xDSL EMS MUST permit an NMS request via the EMS/NMS interface to perform OAM Cell Loopback (i.e., F4/F5), if supported by the NE.

6.3.13 Ethernet Service OAM Connectivity Check

The xDSL EMS MUST allow an NMS request via the EMS/NMS interface to perform an Ethernet Service OAM Connectivity Check, if supported by the NE.

6.3.14 Additional Miscellaneous Loopbacks

The xDSL EMS MUST support an NMS request via the EMS/NMS interface to perform additional miscellaneous loopbacks, as supported by the NE or xDSL EMS.

6.3.15 Alarm Threshold Setting

Alarm thresholds MUST be settable via the NMS-EMS interface on a per connection ID basis, where appropriate.

6.3.16 Alarm Severity Assignment

The ability to edit alarm severity assignments **MUST** be permitted on a per-port basis with or without profile capability. Alarm severities **SHOULD** be enabled/disabled on a per-port basis. Alarm severities **MUST** be assignable on a per-alarm type basis.

6.3.17 Alarm Storage Duration

The length of time that alarm information is kept within the xDSL EMS **SHOULD** be configurable.

6.3.18 Required Alarm Attributes

Alarm messages **MUST** be defined to be consistent with X.733 and X.736 and include the following information:

- alarm type
- priority
- alarm text message
- date and time of occurrence
- description (OPTIONAL)
- recommended resolution (OPTIONAL)

6.3.19 Correlation of Alarms

Correlation of alarms and root cause analysis **SHOULD** be exposed through this interface based on the capabilities of the EMS in this area. This includes the ability to retrieve and set alarm correlation rules.

6.3.20 Testing and Diagnostics

The NMS **MUST** have the ability to query the EMS's testing capabilities, initiate tests, and receive test results from the xDSL EMS.

As supported by the xDSL EMS, the NMS **MUST** initiate copper drop or optical fibre testing and retrieve the test results from the EMS along with any distance to fault estimation. Where this testing is intrusive, the EMS **MUST** suppress any consequent alarm conditions and when possible ensure restoration of service on completion of the tests.

The NMS **MUST** be able to query the managed NE's diagnostic capabilities from the EMS. The NMS **MUST** also be able to trigger diagnostics in an NE and receive diagnostic results from the NE through the EMS.

6.3.21 Loop Testing

The xDSL EMS **MUST** support an NMS request via the EMS-NMS interface to perform tests such as DELT, as supported by the NE or DSL EMS. Data parameters that enable DELT are defined in G.997. 1.

6.4 Performance Management

6.4.1 xDSL Line Performance Data

The NMS MUST be able to initiate a request to the xDSL EMS to obtain xDSL line performance data as defined in Table 7-22/G.997.1 and Section 5.1 of TR-057.

6.4.2 xDSL Channel Performance Data

The NMS MUST be able to initiate a request to the xDSL EMS to obtain xDSL channel performance data as defined in Table 7-24/G.997.1 and Section 5.2 of TR-057.

6.4.3 Retrieval of Performance Monitoring Register Data

The xDSL EMS MUST allow the NMS to retrieve the content of any or all of the PM registers in a NE. This includes parameters related to Transport Level (ATM, Ethernet) QoS.

6.4.4 Suspect Performance Data Indicator

For all performance data transferred to the NMS, the xDSL EMS MUST indicate to the NMS whether the data is suspect (possibly invalid). The characterization of performance data as suspect can be based on a similar indicator from the NE, or based on information that the EMS has about the ability of the NE and the EMS itself to properly measure and record performance data.

6.4.5 Autonomous Performance Data Reporting

The EMS MUST allow the NMS to set filters for the EMS to autonomously forward PM data that the EMS has collected.

6.4.6 Bulk PM Data upload

The EMS MUST provide a bulk PM data upload upon request based on TR-5 1.

6.4.7 Performance History Storage

The xDSL EMS MUST be capable of maintaining historical performance data in 15-minute and 24-hour intervals. For each PM parameter, the EMS MUST store at least the previous 8 hours worth of history PM data in thirty-two (32), 15-minute registers and the previous 24-hour count of PM information in one (1), 24-hour register. Requests (by the NMS) for current 15-minute and 24-hour data MUST result in the EMS making a pass-through request to the NEs to retrieve this information and forward it to the NMS.

6.4.8 Threshold Crossing Alerts

The xDSL EMS MUST report threshold crossing alerts received from NEs or detected by the EMS. The EMS MUST allow the NMS to define filters for the reporting of threshold crossings.

The xDSL EMS MUST allow the NMS to set and modify the PM thresholds or collection of PM data on a per termination point basis in the NE.

The xDSL EMS MUST allow the NMS to set and modify the xDSL Threshold Templates as defined in TR-129.

6.4.9 Impairment and Congestion Indications

If the EMS is capable of integrating multiple threshold crossings over multiple PM data intervals to declare a persistent impairment, the EMS **MUST** be able to forward these impairment indications to the NMS and allow the NMS to retrieve and set the criteria for an impairment declaration. Impairment indications **MUST** be reported using an alarm or event message.

6.4.10 Usage Information

To support service planning and development the xDSL EMS **SHOULD** supply on demand to the NMS usage information, including fixed cost services, e.g. viewing statistics, user demand at specific times, utilization of path capacity.

6.4.11 Capacity information

To support service planning and development the xDSL EMS **SHOULD** supply on demand information on the availability of platform capacity at various levels of granularity, e.g. specific Access Nodes.

To support network inventory management and network planning and development, the NMS **MUST** be able to request from the xDSL EMS:

- The capacity used by Network Element ID, including subsidiary network elements.
- The capacity available for a specific port identifier and service type

The xDSL EMS **MUST** return the total capacity and the capacity used by Network Element ID, or port identifier.

6.5 Security Management

6.5.1 Set Privileges, Authentication Data and Passwords for Access to NE(s)

The EMS **MUST** allow the NMS to retrieve NE security data including current account names to access that NE. The NMS will then have the ability to remotely set up user accounts with privileges and modify/change user account information in the NE(s). The EMS **MUST** also allow the NMS to change all the user accounts associated with the NE(s) with one command. The EMS **MUST** allow the NMS to add/delete a specific account name on all NE(s) with one command.

6.5.2 Set Privileges, Authentication Data and Passwords for Access to EMS

The EMS **MUST** allow the NMS to retrieve EMS security data including current account names to access that EMS. The NMS **MUST** then have the ability to remotely set up user accounts with privileges and modify/change user account information in the EMS(s). The EMS **MUST** also allow the NMS to change all its user accounts with one command.

6.5.3 Autonomous Reporting of NE Security Messages

Via the EMS/NMS interface, the NMS MUST receive any NE autonomous messages which are related to occurrence of NE security violation events. Filtering of these messages SHOULD be provided on a NMS-controlled basis.

6.5.4 NMS/EMS Interface Link Security

The NMS/EMS interface MUST support appropriate link layer security mechanisms.

6.5.5 NMS/EMS Interface Access Control

Access Control allows association of appropriate access permissions with resources. Resources can be either physical (modems, Links, Line Cards) or logical (VCC) entities. Only specific operations indicated by the Access Control information are permitted on a resource. NMS & EMS applications MUST support an Access control mechanism to associate specific permissions with resources and to protect resources from unauthorized operations. Joint implementation agreements and development will be needed between the ADLS EMS and Broadband NMS suppliers.

6.6 Accounting Management

In order to support usage measurement and billing scenarios the EMS MUST provide access to usage measurement data on each connection ID. The NMS MUST be able to start and stop the usage measurement via the EMS-NMS interface and request their current values at any time. Switching event and cell or packet count information MUST be labeled with start and stop times.

The NMS MUST be able to set the usage information storage time via the EMS-NMS Interface.